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ABSTRACT

The purpose of this study was to investigate the relationship between testing condition and student test scores. The testing conditions studied were: independent, cheat sheet, homogenous grouping with cheat sheet, and heterogeneous group without cheat sheet. Participants were 141 undergraduates in a course required for entry into the teacher education program at a regional state university. Five tests were given over the course. The first two were given in traditional fashion (independent work), and the others each embodied one of the testing conditions. Heterogeneous group discussion resulted in the highest average test score. All the alternative formats resulted in higher scores than students earned in the traditional individual format. Additional research is necessary to determine why the homogeneous group discussions resulted in the highest scores, but it may be that thinking together is powerful scaffolding for dealing with the mechanics of testing. (Contains 5 tables, 2 figures, and 28 references.) (SLD)

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The Relationship Between Testing Condition and Student Test Scores

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The Relationship Between Testing Conditions and Student Test Scores

Those challenged with facilitating student learning at all instructional levels recognize that student engagement is key to academic competence. Effective study skills are foundationally important to competence in both academic and non-academic settings (Gettinger & Seibert, 2002). These include competencies associated with acquiring, recording, organizing, synthesizing, remembering and using information (Hoover & Patton, 1995). Pressley & Afflerbach (1995) identified several key strategies that facilitate learning. These included (a) overview before reading, (b) attention to important information, (c) relating / connecting important points, (d) activation and use of prior knowledge, (e) changing strategies when appropriate, and (f) monitoring understanding and taking action to enhance comprehension. Ideally students who have progressed through formal education systems to the college level have acquired such tactics, strategies and self-regulative skills that direct and enhance their ability to learn. However, students may enter post-secondary level institutions without knowledge of and previous practice with these skills and strategies (Schumacker & Sayler, 1995).

Additionally, there seems to be a tradition of bias in the American educational system toward individual accountability and responsibility (Meinster & Rose, 1993). This would seem to inhibit adoption of and engagement in cooperative learning endeavors, even though the benefits have been repeatedly demonstrated. However, studies repeatedly show that cooperative and collaborative learning environments enhance both classroom climate and student performance (e.g., Aronson, Stephan, Blaney, Sikes, & Snapp, 1978; Webb, 1997).

The basis for much of the cooperative learning movement originates from the work of Lev Vygotsky. Vygotsky (1978) believed that social interactions are the foundation of cognitive development. Through the utilization of cultural sign systems, of which language is the most pervasive and efficient, students help each other learn conceptual material. Often they learn just as well or better during these peer interactions as they would if teachers work with students. Vigorous cooperative engagement improves learning (Duffy & Bednar, 1991; Kember & Murphy, 1990;Vygotsky, 1978). It follows that debate, negotiation, and discussion regarding conceptual material would be effective ways to increase student learning, improve reasoning and facilitate the development of improved learning strategies and new knowledge that they might not gain independently (Damon & Phelps, 1989; Gabbert, Johnson, & Johnson, 1987; Johnson, Johnson, & Smith, 1990;). Research has shown that cooperative learning techniques are positively associated with (a) performance on academic tasks (Johnson, Johnson, & Smith, 1990), (b) student self-esteem and student attitudes toward school (Slavin, 1991), and (c) reduced test anxiety (Meinster & Rose, 1993). In addition, Webb (1997) found that students who actively participated in group problem-solving activities, either by asking for help or in leading the group, performed better on subsequent individual tests. However, students who did not participate performed poorly on subsequent individual tests. Webb concluded that if learning is the goal of the teacher and the classroom, then the learning processes should include "exchanging and discussion ideas, opinions, and knowledge; helping others; working together rather then separately; actively seeking help and clarification; encouraging others to participate; justifying and explaining one's own ideas; and elaborating on others' ideas" (1997, pp. 209-210).

It follows that, if tests are to be a learning experience as well as an assessment, and the teacher's goal is student learning and mastery of conceptual material, allowing cooperation during test-taking would be a 'natural' extension of Vygotsky's theory (Klecker, 2002). Research on cooperative test-taking reports improved student attitudes about themselves, about the subject or course, and a reduction in anxiety (Zimbardo, Butler, & Wolfe, 2003; Klecker, 2002; Giraud & Enders, 1998; Becker & Cardulla, 1995), as well as somewhat higher test scores than independent testing (Zimbardo, Butler, & Wolf, 2003; Lambiotte et al., 1987). These results were found in studies conducted in chemistry, statistics, psychology, and education courses.

Reviewing of content materials, as well as course notes, has been recognized as an important study strategy. Instructors often encourage students to revise and rewrite individual course notes to increase total study time and familiarity with the examination materials. Loftman (1975) found that time spent reviewing was a better predictor of grades than total study time, assignment preparation, and time spent in study groups. Zimmerman and Pons (1986) found that student reviews of content materials and other self-regulated learning strategies discriminated among achievement tracks of high school students. In the interest of improving scores on tests, students will sometimes spend time in the preparation of cheat sheets or crib cards, which may be considered as products derived from the process of advanced preparation. Of course, the intuitive intent, for some students, is to use such devices secretly to facilitate the test performance. Some instructors have implemented the 'legal' use of cheat sheets in testing situations (Dorsel & Cundiff, 1979; Hindman, 1980). Some studies show that testing situations that allow the use of "cheat sheets" or "crib cards" (i.e., notes the students have prepared ahead of time

to use during an examination or test) have the effect of improving student attitudes and lowering anxiety (Cherim, 1981). More importantly, preparing cheat sheets or crib cards seems to help students to review, organize and clarify the main points of material that will most likely appear on a test. (Tips for beginners, 1992; Cherim, 1981; Hindman, 1980). Hindman (1980) found that students who did better academically were more likely to prepare and use "legal" crib cards, which was also associated with a slight increase in test scores. However, Dorsel and Cundiff (1979) found that cheat sheet preparation did not improve student performance if the student was depending upon it being available in a test situation. When students made out a cheat sheet but knew they were not permitted to use it during the test (i.e., non-dependent), they performed as well as when a cheat sheet was not made at all, or made and not used. It should be noted that construction of the cheat sheet followed the administration of a pretest and followed a prescribed text as a model (i.e., summary paragraph regarding Freud), and was not prepared before class time. This type of advanced preparation is in contrast to "open book" exams, where students who come into the test or exam situation unprepared do not benefit from the availability of notes and textbook use during the exam (Boniface, 1985).

Certainly encouraging and supporting energetic engagement with course material, either before or during a test, would seem appropriate. It follows from the research on advanced preparation and cooperative testing that combining both a cheat sheet and group discussion option in testing situations might help lower-achieving students achieve better test scores. Lower-achieving students tend not to make cheat sheets or crib cards (Hindman, 1980), and their analysis of multiple-choice question alternatives was found to be poorer than that of "A" students (McClain, 1983). However, whether or not any

member of a group prepared a cheat sheet, it seems probable that a discussion format would benefit lower-achieving students. They might be more likely to read, discuss, and analyze all the alternatives presented for individual questions with the members of their group. This would result in better conceptual understanding and higher test scores. Preparation of a cheat sheet by even one member of the group might provide clarification of test items and response alternatives for all members of the group, thereby facilitating understanding of all members or the group.

Therefore, the purpose of this study was to investigate the relationship between testing condition (i.e., independent, cheat sheet, homogenous grouping with cheat sheet, and heterogeneous group without cheat sheet).

Methods

One hundred forty-one (141) undergraduate students enrolled in a course required for entry to the teacher education program at a regional state university in the Mid-South were participants in this study. All four sections of the course were taught by the same instructor and had identical multiple-choice tests and test conditions. Five tests were given over the course of the semester and none was comprehensive.

The first two tests were administered in the traditional fashion, with students working alone to complete the assessments. For Test 3, students were told in advance that they could prepare an 8 ½ by 11 inch sheet of paper with whatever information they wanted handwritten on both sides. This "cheat sheet" could be brought to class and used during the test.

For Test 4, students were told that they would be allowed to discuss the test in groups of three or four prior to marking their answers. The groups were announced at the

beginning of the class period during which the test was taken, but students were not told the basis on which groups were formed. Groups were assigned randomly (using a random number table), but stratified on the average performance on the first two tests. Thus each group contained (at a minimum) a student who had performed at the A or B level previously, one who had achieved at the C level, and one who had scored at the D or F level. Students wishing to opt out of the group discussion were allowed to do so. The instructor rearranged group membership as necessary to account for those opting out (n=12) or absent (n=11). Students choosing the discussion option met with their groups in the hallway outside the classroom, but they were not allowed to make any notes on their exams during the discussion. Members of each group returned to the classroom to mark their exams individually when their group was finished talking over the items.

For Test 5, students were told they could bring in a cheat sheet (as on Test 3) and they also would be allowed to discuss the test with a different group prior to marking their answers. As before, students were not told the basis of group assignment. For Test 5, the instructor assigned students into homogeneous grade groups, based on their average score on the first two individual exams. This meant that three to five students who had earned an A average individually were grouped together for discussion, as were students in the B range, and so on. Students could refer to their cheat sheets during discussion, but could not write on them or on the test papers during group time. Again, pre-assigned groups had to be rearranged somewhat because of students opting out (23) or absent (7). (Table 1 displays the numbers of students from each grade group who opted out of the group discussion alternatives. The make-up of the homogeneous grade groups is contained in Table 2.)

Analysis

Descriptive and statistical data analyses were conducted. The Wilcoxon signed-rank tests (Siegel, 1956) was used to determine whether one of the alternative testing conditions resulted in students earning higher scores compared to the traditional format. The nonparametric Wilcoxon was chosen rather than a one-sample t-test because the study employed a convenience sample not randomly chosen from a specific population. Descriptive statistics and frequency distributions were generated for the whole sample and for the homogeneous grade groups. Individual data regarding the use or nonuse of cheat sheets were not collected, so for the sake of consistency statistics were calculated using the entire sample, even though some students did not make and use cheat sheets, or did not engage in discussion with classmates.

Results and Discussion

Descriptive statistics for all test formats are displayed in Table 3 and Figure 1. Heterogeneous group discussion resulted in the highest average test score (90%). The differences between test scores under alternative formats and the highest score earned in the traditional format were calculated and are contained in Table 4, along with the Wilcoxan results. The final entry in Table 3 is the difference score between the two cheat sheet formats – one having a homogeneous group discussion option in addition. The probabilities of each Wilcoxan test was less than the Bonferroni-corrected alpha of 0.0127, so each difference was statistically significant. All alternative formats resulted in higher scores than students earned in the traditional individual format, despite including non-participant student scores in the analyses.

Inspection of the means clearly showed that discussion in heterogeneous groups had the largest effect, but in that situation it could have been the higher achieving students in the group giving answers to the lower achievers. This could not have been the case in the homogeneous grade groups discussion option, however, where the data also indicated that discussion with peers at the same achievement level added value to having a cheat sheet alone.

The data in Table 5 and Figure 2 illustrate the different ways in which the grade groups responded to the alternative testing formats. The highest scores across all grade groups except for the 'A' students came with the heterogeneous group discussion format. The 'A' students' highest score (by a small margin) was with the homogeneous discussion / cheat sheet combination format, which was the second highest score for all other groups except the 'B' students. The 'B' students scored 5 points higher on the cheat sheet format than they did when it was combined with homogeneous group discussion. (A tape recorder in the middle of each group during discussion might reveal the cause for this. Perhaps they argued each other out of the correct answer.)

'C' and 'D' students were both helped substantially by a cheat sheet alone, with the 'F' students helped a little less by this format. (It is, of course, possible that the lowest-achieving students did not bother to make a cheat sheet at all.) Adding homogeneous group discussion resulted in 5-7 point gains for the 'C' and 'D' students, but about three times as large a gain (17 points) for the 'F' students. This means that when these lowest-achieving students, two-thirds of whom had not scored higher than 59% individually, talked in groups of three to five about the test, they raised their average test score by nearly two letter grades.

There was no control in the study design over the relative difficulty of the five tests. The differing responses of the grade groups to the alternatives, however, alleviated some of this concern. If the reason that 'F' students performed so well on the last test was simply because it was easier than some of the other exams, then the 'B' students also would be expected to increase their scores on it. This was not the case.

Perhaps the lowest-achieving students were knowledgeable individually in different areas of the content being tested and the group discussion just helped them fill in the gaps for each other. Alternatively, maybe more of them decided to make cheat sheets for the final test, and having those available during the group discussion made the difference in achievement. But it also might be that for these students, thinking together is powerful scaffolding for the task of dealing with the mechanics of testing, such as fully considering all response options before answering the item.

This is an area worth further study. The cause for the increased grades in the homogeneous group discussion alternative is certainly a topic of interest, as noted above. A second related question is whether the content material is retained longer following a particular testing alternative rather than another.

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Table 1

Number of Students in Particular Grade Groups Opting Out of Discussion Formats

	Grade Group				
Test Format	A	B	C	D	F
Heterog. Groups	5	4	1	1	1
Homog. Groups.	6	10	5	2	0

Table 2

Highest Individual Scores of Students in Homogeneous Grade Groups

	Highest Grade Obtained Individually (Number of Students)					
Grade Group	A	B	C	D	F	(Total)
'A' Group	16	2	0	0	0	18
'B' Group	4	13	1	0	0	18
'C' Group	1	20	17	1	0	39
'D' Group	0	0	5	14	0	19
'F' Group	0	0	0	6	11	17

Note: Homogeneous groups were formed based on an average of the first two individually-taken tests. Only 111 students participated in the homogenous group option.

Table 3

Test Score (%) Descriptive Statistics for All Alternative Formats

Test Format	N	Mean	Standard Deviation	Minimum	Maximum
Individual 1	141	73.7	15.6	30	100
Individual 2	141	71.6	13.8	42	100
Cheat Sheet (C.S.)	141	80.7	12.7	44	100
Heterog. Groups	140	90.1	8.3	58	100
Homog.Grp/C.S.	139	84.0	9.0	60	100

Note: Means include scores of all students, even those who did not choose to use a cheat sheet or work in groups.

Table 4

Wilcoxan Signed Rank Tests for Differences between Testing Formats

Format Comparison	N	Mean	Standard Deviation	S	Pr > S
C.S. - Highest Indiv.	141	2.7	11.0	1179	0.0069
Hetero.Grp - H.I.	140	12.0	13.0	3571	< 0.0001
Homog.Grp - H.I.	139	5.8	12.0	2209	< 0.0001
Homog.Grp. – C.S.	139	3.1	12.3	1188	0.0110

Note: Means include difference scores for all students, even those who did not choose to use a cheat sheet or work in groups.

Table 5

All Test Score Descriptive Statistics for Each Homogeneous Grade Group

Test and Group	Mean	Standard Deviation	Minimum	Maximum
Individual 1				
'A' Group	93.4	5.6	80	100
'B' Group	79.7	9.6	58	94
'C' Group	75.0	9.4	50	89
'D' Group	61.5	9.0	45	79
'F' Group	49.6	8.8	30	65
Individual 2				
'A' Group	86.9	5.8	77	97
'B' Group	81.9	6.7	72	93
'C' Group	70.6	9.2	49	94
'D' Group	63.0	7.0	46	79
'F' Group	51.9	8.3	42	69
Cheat Sheet (C.S.)				
'A' Group	91.6	7.2	74	100
'B' Group	85.8	9.0	65	97
'C' Group	80.8	7.2	67	96
'D' Group	74.5	7.8	64	91
'F' Group	60.5	11.6	44	82

Table 5, cont.

Test and Group	Mean	Standard Deviation	Minimum	Maximum
Heterog. Groups				
'A' Group	94.2	5.1	87	100
'B' Group	90.7	6.1	77	100
'C' Group	91.7	7.9	69	100
'D' Group	89.6	6.4	71	96
'F' Group	84.2	12.9	58	97
Homog.Grp/C.S.				
'A' Group	95.0	4.9	86	100
'B' Group	80.7	7.3	69	94
'C' Group	86.4	7.4	68	100
'D' Group	81.1	5.3	70	91
'F' Group	76.8	8.8	60	89

Note: Means include only scores of the 111 students participating in the homogeneous group discussion alternative.

Figure 1: Grade Distribution Across Tests

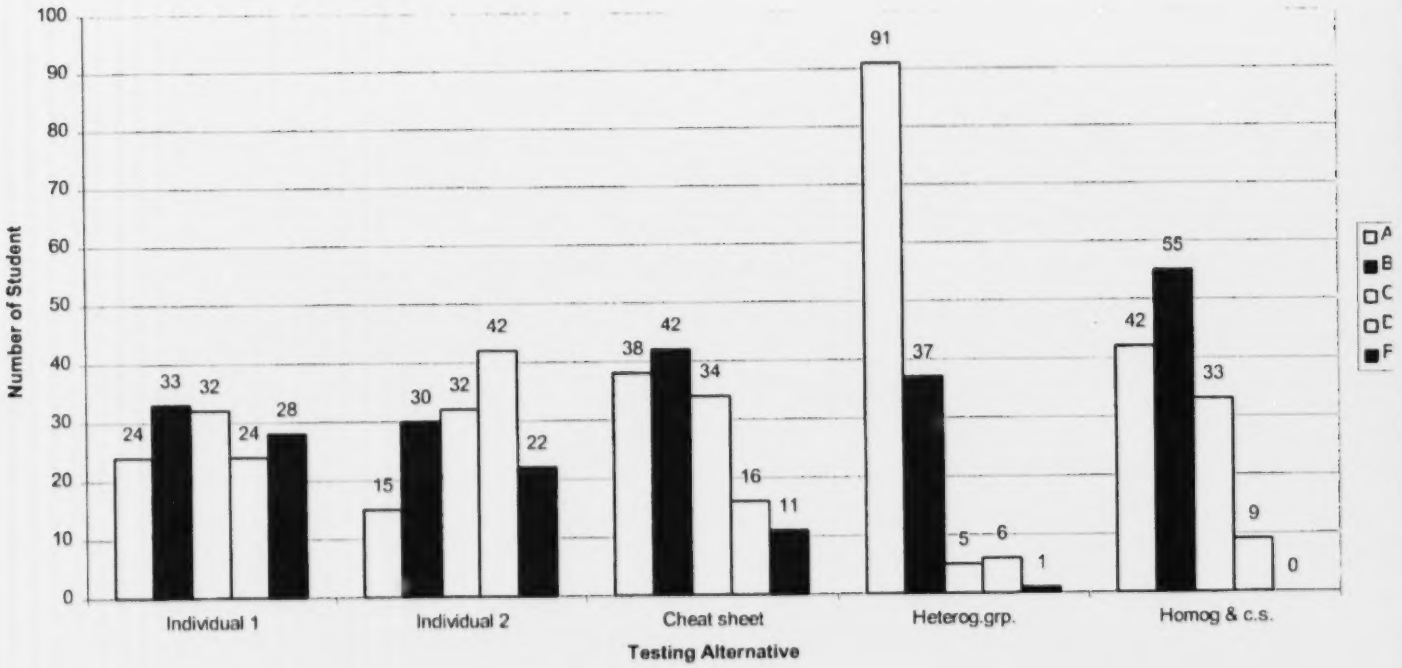
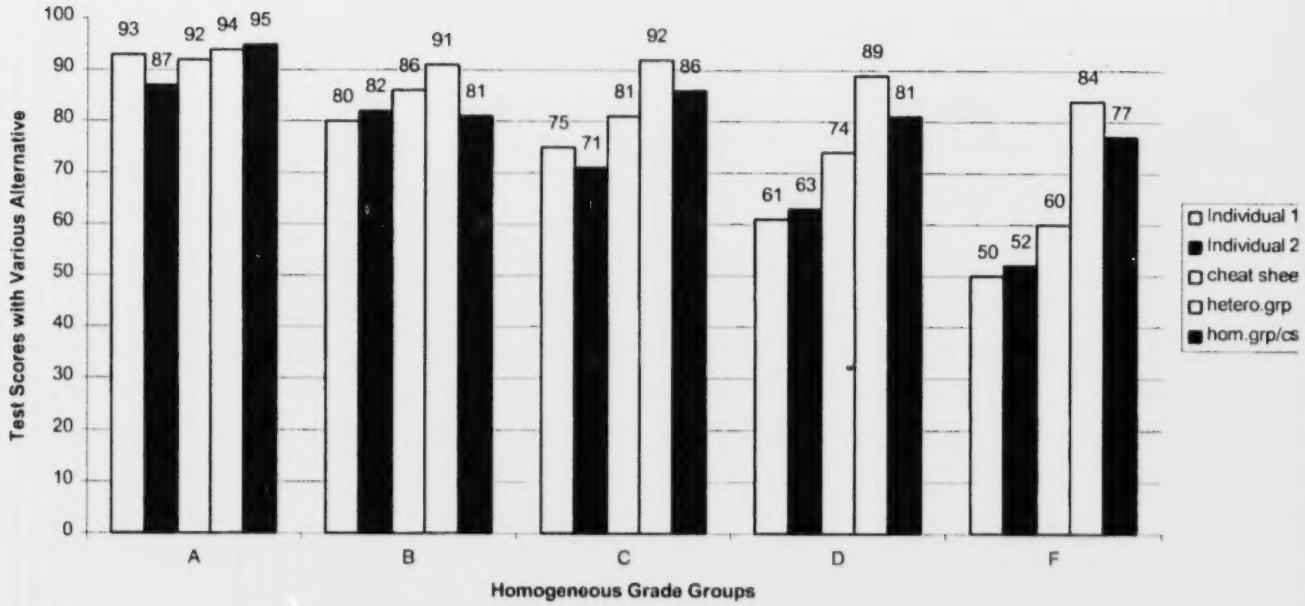


Figure 2: Test Scores of Homogeneous Grade Groups



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